



8-Foot High Temperature Tunnel

NASA Langley Research Center

*The Langley 8-Foot High Temperature
Tunnel simulates true enthalpy
at hypersonic flight conditions
for testing advanced large-scale
flight-weight aerothermal, structural,
and propulsion concepts.*



**Wind Tunnel
ENTERPRISE**

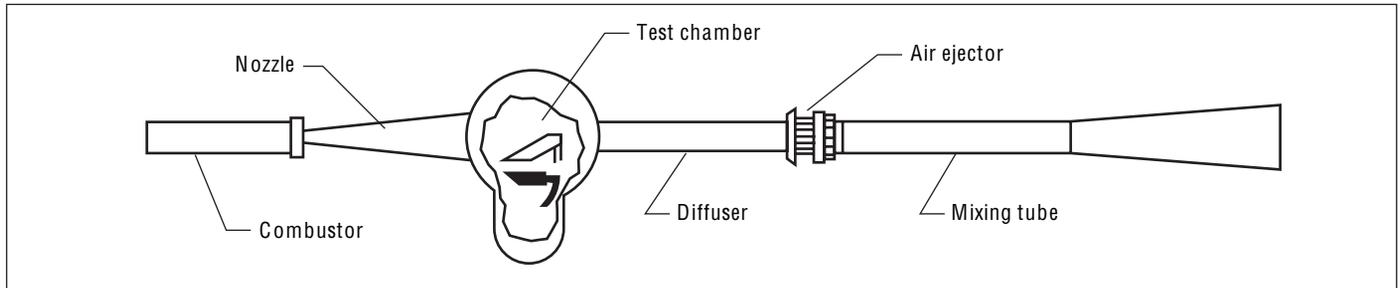
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Test Section and Performance

The Langley 8-Foot High Temperature Tunnel (8-Ft HTT) is a combustion-heated hypersonic blowdown-to-atmosphere wind tunnel that provides simulation of flight enthalpy for Mach numbers of 4, 5, and 7 through a range of altitude from 50,000 to 120,000 ft. The open-jet test section is 8 ft in diameter and 12-ft long. The

test section will accommodate very large models, air-breathing hypersonic propulsion systems, and structural and thermal protection system (TPS) components. Stable wind tunnel test conditions can be provided up to about 60 sec. Additional simulation capabilities are provided by a radiant heater system

that can be used to simulate ascent or entry heating profiles. The high-energy test medium is the combustion products of air and methane that are burned in a pressurized combustion chamber. Oxygen is added for air-breathing propulsion tests.



Schematic of the 8-Foot High Temperature Tunnel.

Mach Number	4	5	6
Stagnation Pressure, psia	50 to 310	90 to 530	600 to 3500
Stagnation Temperature, °R	1640	2350	2500 to 3650
Dynamic Pressure, psf	525 to 3100	350 to 2000	320 to 1900
Reynolds Number, 10 ⁶ /ft	0.87 to 5.09	0.44 to 2.58	0.3 to 3.0
Altitude Simulation, k-ft	47 to 85	65 to 100	80 to 120
Heating Rate, BTU/ft ^{1.5} - sec	7.0 to 17.0	10.5 to 25.3	20 to 48

Model Supports

The hydraulic-actuated model insertion system can support (1) an arc sector pitch strut assembly that provides $\pm 20^\circ$ angle of attack for models up to 10,000 lb and (2) a force measurement system that is used for pedestal-mounted propulsion models up to 40,000 lb.

Electrical power, cooling water, hydraulic lines, high-pressure air, nitrogen, and other gases are available to all models. These resources can be regulated to suit customer requirements.

Safety and Design Criteria

Langley's LHB 1710.15 *Wind Tunnel Model System Criteria* is the guideline for model design and fabrication. Model installation and any exceptions to this document must have the approval of the 8-Ft HTT Safety Head on a case-by-case basis to assure personnel and tunnel hardware are not exposed to risk.

This document is available on the Wind Tunnel Enterprise web site at URL <http://wte.larc.nasa.gov>

In addition, the model installation must have the approval of the facility safety head prior to tunnel operation.

Instrumentation

The 8-Ft HTT typically utilizes standard strain gauge, pressure transducer, electronically scanned pressure (ESP), and thermocouple instrumentation mounted inside or external to the model.

Model Observation

Both sides of the test section have extensive optical access that can be used for Schlieren or standard video and photography at normal or high-speed rates. Infrared imaging and additional video cameras for observation are available inside the test section.

Facilities Available to Users

A shop area is provided at the facility for buildup of models.

Data Acquisition and Processing

The 8-Ft HTT data acquisition system consists of an analog-to-digital (A/D) converter, an ESP system, and a dynamic data acquisition system. The A/D converter can acquire 512 channels with a typical scan rate of 50 Hz. Uniform temperature reference devices provide thermocouple routing and compensation. The A/D signal conditioners provide excitation supply, bridge completion, and resistance calibration for wire strain-gauge based sensors.

The ESP system acquires 1024 channels. The system currently supports ESP modules ranging from 1 psid to 750 psid. Typical acquisition rate is 10 Hz.

The dynamic data acquisition system can accommodate up to 31 channels. The maximum sample rate is 1×10^6 samples per second per channel for 2 seconds.

The A/D and ESP systems interface with a personal computer (PC) which runs commercial-off-the-shelf data acquisition and control software. This software performs device interfacing and calibration; near real-time display; and data acquisition, conversion, and transfer. The engineering unit data from the A/D and ESP systems are transferred from the PC to a workstation for posttest processing. The workstation runs custom data processing software that performs corrections for transducer excitation, ESP reference, wind-off data referencing, and specialized calculations. This software produces graphs and tabular listings after each tunnel run from a pre-defined setup. An interactive interface is also available. Transportability to commercially available or third party software is provided. Data file transfer and archiving is accomplished through TCP/IP (FTP), 8 mm tape, or 4 mm tape.

Test Request Procedures

The first step of the test process is to submit a test request form. The form can be filled out electronically or printed for mailing at the Wind Tunnel Enterprise web site. A posttest

questionnaire is also available at this site. The URL is <http://wte.larc.nasa.gov>. Our customers are encouraged to provide feedback to the facility for our continuous improvement process.

Test Capabilities

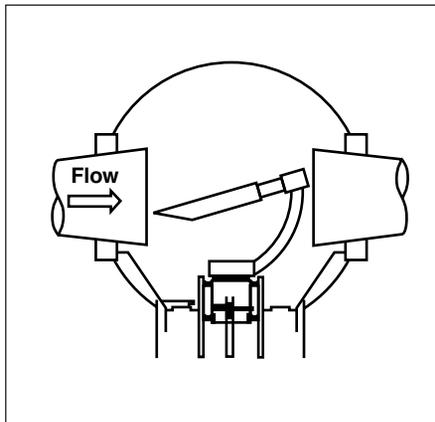
Thermal Protection System

The TPS and the aerothermal loads definition tests (e.g., Space Shuttle, X-33) can be conducted by installing a model into a panel holder supplied by the facility. A sting attaches this panel holder to the curved strut pitch system mounted on the model elevator.



TPS panel holder.

The test article can be exposed to the desired heating profile with a 1-MW radiant heater system to simulate complete ascent or entry heating profiles prior to and immediately following insertion into the desired wind tunnel test condition.



Panel holder in test section.

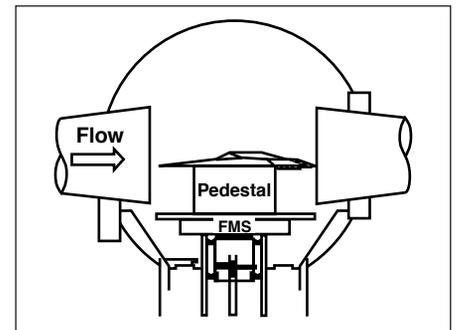
Test Capabilities

Propulsion

Hypersonic air-breathing propulsion system tests are performed with the propulsion test article (e.g. NASP concept demonstration engine, Hyper-X flight vehicle) attached to a model support pedestal mounted on an external force measurement balance. Propellant fuel (e.g. gaseous hydrogen, liquid hydrocarbon) and purge gases are supplied to the test article by the facility.



NASP concept demonstration engine model.



Propulsion engine test model support.

Operating Hours

The 8-Ft HTT operates
one shift per day
Monday through Friday
7:00 am - 3:30 pm

For more information contact

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